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By Steve Bush 9th December 2021

650V automotive-grade SiC mosfet launches ST's Gen3

STMicroelectronics had debuted its third generation of silicon carbide mosfet with a 650V device aimed at electric-vehicle power-trains.

Called SCT040H65G3AG, the part typically has a 40mΩ on-resistance and can carry 30A through its Kelvin source H2PAK-7 package (**right**).

Regarding gen 3 "ST's new SiC devices are specifically optimised for automotive applications including traction inverters, on-board chargers and dc-dc converters, as well as e-climate compressors," it said. "The new generation also suits industrial applications – motor drives, renewable-energy converters and storage systems – as well as telecom and data-centre power supplies."

The SiC 650V mosfet initially is for evaluation, with limited samples available. According to the company it has completed qualification of its third-generation SiC technology platform and expects to move most of the derivative products to commercial maturity by the end of 2021.

For gate driving, the recommended operating range is between -5 and 18V, with -10 to 22V absolute maximum values, and a usefully-defined gate transient rating: 10 hours of sub-microsecond -11 or 25V pulses accumulated over the product life time, if Electronics Weekly has understood correctly – the data sheet link is below.

Devices with nominal voltage ratings of 650V, 750V and 1,200V will be amongst those available, suiting ac-line voltages and high-voltage vehicle batteries including 800V

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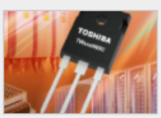
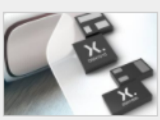

650V SiC mosfets get better Rds(on) and Qg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Devices with nominal voltage ratings of 650V, 750V and 1,200V will be amongst those available, suiting ac-line voltages and high-voltage vehicle batteries including 800V types.

Third-generation transistors will be offered in packages including STPAK, H2PAK-7L, HiP247-4L and HU3PAK, as bare die, and in the AcePack family of power modules.

These are planar devices with a fast intrinsic diode "that deliver the bi-directional properties needed for automotive on-board chargers used in V2X [vehicle-to-x] power flow" said ST.

The SCT040H65G3AG product page is here and the data sheet is here

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14 December 2021

ST launches third generation of STPOWER SiC MOSFETs

STMicroelectronics of Geneva, Switzerland is introducing its third generation of STPOWER silicon carbide (SiC) metal-oxide-semiconductor field-effect transistors (MOSFETs), intended for electric vehicle (EV) powertrains and other applications where power density, energy efficiency and reliability are important target criteria.

Due to the acceleration of the EV market, many car makers and automotive suppliers are now embracing 800V drive systems to achieve much faster charging and help reduce EV weight. These new systems allow the car makers to produce vehicles with longer driving ranges. ST's new SiC devices are specifically optimized for these high-end automotive applications including EV traction inverters, on-board chargers, and DC/DC converters, as well as e-climate compressors. The new generation also suits industrial applications by boosting the efficiency of motor drives, renewable energy converters and storage systems, as well as telecom and data-center power supplies.

"We continue to drive this exciting technology forward with innovations at both the device and package levels. As a fully integrated SiC products manufacturer, we are able to deliver continued improved performance to our customers," says Edoardo Merli, Power Transistor Macro-Division general manager & group VP of STMicroelectronics' Automotive and Discrete Group. "We are investing relentlessly to support our automotive and industrial programs expected to generate $1bn in SiC revenue in 2024."

ST has completed qualification of the third-generation SiC technology platform and expects to move most of the derivative products to commercial maturity by the end of 2021. Devices with nominal voltage ratings from 650V and 750V up to 1200V will be available, giving more choices for designers to address applications operating from ordinary AC-line voltages up to those of high-voltage EV batteries and chargers. The first products available are the 650V SCT040H65G3AG, priced at $5, and a 750V device in die form (datasheet and quotation upon request).

Leveraging the new third-generation SiC platform, ST's latest planar MOSFETs set what are claimed to be industry-leading benchmarks for the accepted figures-of-merit (FoMs) [on-resistance (R_{on}) x die size, and R_{on} x gate charge (Q_g)] that express transistor efficiency, power density and switching performance. Bettering FoMs using ordinary silicon technology has become increasingly difficult and, as a result, SiC technology holds the key to further improvement.

Compared with silicon alternatives, SiC MOSFETs also have a higher voltage rating in relation to their die size, making the technology an excellent choice for EV applications and fast-charging EV infrastructures, says ST. In addition, they benefit from a very fast intrinsic diode that delivers the bi-directional properties needed for automotive on-board chargers (OBCs) used in Vehicle-to-X (V2X) power flow allowing the transmission of electricity from an OBC battery to the infrastructure. Moreover, their very high-frequency capability allows smaller passive components within power systems, permitting more compact and lightweight electrical equipment in the vehicle. The same attributes also lower ownership costs in industrial applications.

ST will offer the third-generation devices in various forms, including bare dice, discrete power packages such as STPAK, H2PAK-7L, HiP247-4L and HU3PAK and power modules of the ACEPACK family. The packages offer design features such as specially placed cooling tabs that simplify connection to base-plates and heat spreaders in EV applications. The options give designers choices that are optimized for applications such as EV main traction inverters, on-board chargers, DC/DC converters, e-climate compressors, and industrial

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January 19, 2022 Maurizio Di Paolo Emilio

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STMicroelectronics has recently introduced its third generation of STPOWER silicon carbide (SiC) MOSFETs, targeting advanced power applications (such as EV powertrains) and other applications where power density, energy efficiency, and reliability are relevant key factors.

The transition to electrical mobility and the gradual replacement of internal combustion engines are driving the race to make increasingly efficient electric vehicles (EVs). For these applications, power electronics plays an essential role, allowing for more efficient inverters, converters, powertrains, and on-board chargers. Power devices used in EVs, as well as in many industrial applications such as EV charging stations, industrial drives, power supply for datacenters, energy generation and storage, must meet specific requirements related to power losses, breakdown voltage, switching frequency, maximum operating temperature, and thermal conductivity.

Even though silicon-based power devices have been widely used in power electronics for years, they exhibit some important limitations, including low bandgap energy, limited switching frequency, and low thermal conductivity. Wide bandgap devices (WBG), such as silicon carbide provide larger bandgaps, higher breakdown voltages and better thermal management. As a result, WBGs are replacing silicon devices in high voltage, high switching frequency, and high-temperature applications.

ST 3rd Gen SiC MOSFET for the EV Market

With the acceleration of the EV market, car makers are demanding higher voltage (such as 800V) drive systems to reduce charging time and overall EV weight, which in turn means longer driving ranges. ST 3rd generation STPOWER SiC MOSFETs have been specifically designed to meet the requirements of high-end automotive applications, including EV traction inverters, on-board chargers, and DC/DC converters (see Figure 1).

The new SiC-based devices are also suitable for industrial applications. In these, they can increase the

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STPOWER SiC MOSFETs have been specifically designed to meet the requirements of high-end automotive applications, including EV traction inverters, on-board chargers, and DC/DC converters (see Figure 1).

The new SiC-based devices are also suitable for industrial applications. In these, they can increase the efficiency of motor drives, renewable-energy converters and storage systems, as well as telecom and data-center power supplies.

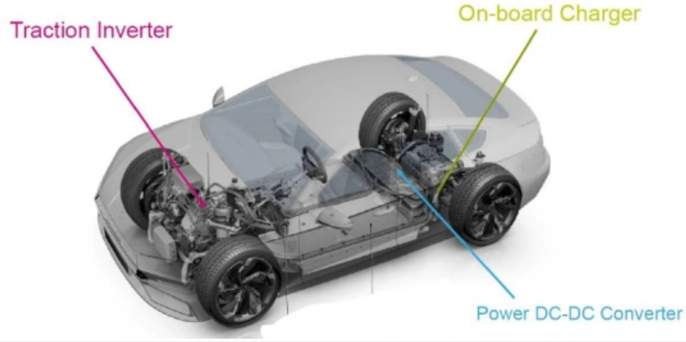


Figure 1: high-end EV applications (source: ST)

ST's latest STPOWER SiC MOSFETs set the bar for industry-leading benchmarks for the accepted figures of merit (FoMs) that express transistor efficiency, power density, and switching performance.

"This year, we started the production of our third-generation STPOWER SiC MOSFET, which offers a range of noticeable improvements with respect to the second generation products suiting ever-demanding requirements from our customers," said Filippo Di Giovanni, Strategic Marketing Manager, Power Transistor Macro-Division at STMicroelectronics.

Among these improvements: the *on-resistance (Ron) x die size FoM has been improved by 30%, while the Ron x gate charge (Qg) FoM has* been improved on average by 50%.

The new devices will be available with nominal voltage ratings from 650V and 750V up to 1200V with 900V as intermediate step, providing designers with the flexibility required to address applications operating with ordinary AC-line voltages, up to those with high-voltage EV batteries and chargers. The 750V voltage variant provides extra voltage margin and has been introduced for the first time, in response to precise requests coming from customers.

"Historically, 750V voltage variant has been introduced for IGBTs. Since silicon carbide MOSFETs can replace IGBTs in more efficient applications, we are providing an extra voltage option which improves system performance without affecting the maximum voltage requirements," said Di Giovanni.

Figure 2 shows, with a greater detail, how SiC MOSFETs can effectively replace IGBTs and Si MOSFETs in EV applications.

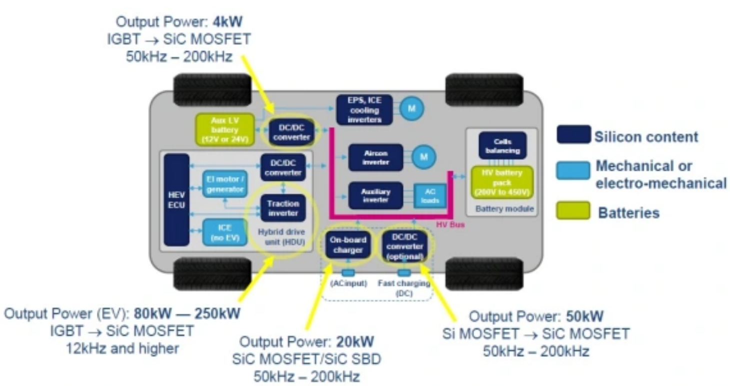
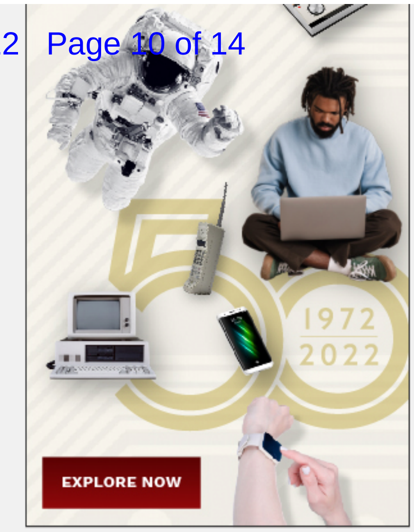


Figure 2: replacement of silicon- with SiC-based devices in EVs (source: ST)

Compared to their silicon alternatives, SiC MOSFETs feature a higher voltage rating in relation to their die size, making these devices an excellent choice for EV applications and fast-charging EV infrastructures. In addition,



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“The achievements and improvements have been possible thanks to our proprietary planar technology that still lends itsels to further refinements. possible. In fact, we are still going down on our roadmap and anticipate being able to introduce a fourth planar iteration ,in a couple of years ” said Di Giovanni.

At ST, engineers have also started working on advanced simulations of new structures leveraging ST’s long-standing knowledge and expertise in power semiconductors.. They are in the beginning stages and are still busy improving the planar structure, which they consider among the best approaches for making silicon carbide MOSFETs.

ST will offer the third-generation devices in different forms, including bare dice, discrete power packages such as STPAK, H2PAK-7L, HiP247-4L, and HU3PAK and power modules of the ACEPACK family. The packages, too, offer innovative design features such as specially placed cooling tabs that simplify connection to base-plates and heat spreaders in EV applications. The options give designers choices that are further optimized for applications such as EV main traction inverters, on-board chargers (OBCs), DC/DC converters, e-climate compressors, and industrial applications such as solar inverters, energy storage systems, motor drives and power supplies.

Regarding the applications, Di Giovanni thinks that the largest market will continue to be in electric vehicles. In terms of volumes, he thinks the automotive sector will still drive the production capacity for silicon carbide even if the Company has already started serving the high-end industrial market. When ST started the production of its first 1200V SiC MOSFET in 2014, it was targeted primarily to the solar inverter market. Then, they took the courageous decision to use this brand new technology for the nascent EV market, allowing ST to become an undisputed market leader in this technology.

“After having tested and debugged this technology in the hostile and harsh environment of automotive applications, we can safely propose this technology to any other market, including the industrial market,” said Di Giovanni.

To meeting growing demand, ST is expanding the production and the manufacturing capacity of its silicon carbide MOSFETs. After starting a second 6” line in Singapore, ST has expanded the capacity of their main site in Catania (Italy), successfully reproducing the first 8” SiC prototypes, first by realising diodes.

“We plan to reach $1 billion mark in revenues on all silicon carbide products in 2024, which is one year earlier than we’d previously announced,” said Di Giovanni.

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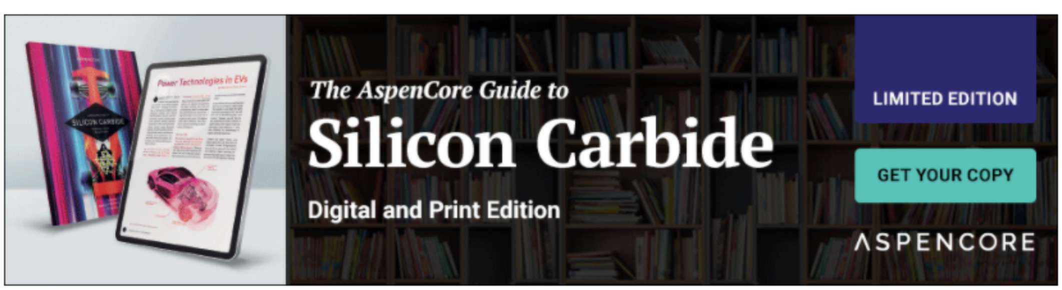

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October 4, 2022 Maurizio Di Paolo Emilio

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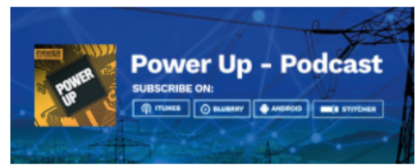

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Maurizio Di Paolo Emilio

Maurizio Di Paolo Emilio holds a Ph. D. in Physics and is a Telecommunications Engineer. He has worked on various international projects in the field of gravitational waves research, designing a thermal compensation system (TCS) and data acquisition and control systems, and on others about x-ray microbeams in collaboration with Columbia University, high voltage systems and space technologies for communications and motor control with ESA/INFN. TCS has been applied to the Virgo and LIGO experiments, which detected gravitational waves for the first time and earned the Nobel Prize in 2017. Since 2007, he has been a reviewer for scientific publications for academics such as Microelectronics Journal and IEEE journals. Moreover, he has collaborated with different electronic industry companies and several Italian and English blogs and magazines, such as Electronics World, Elektor, Mouser, Automazione Industriale, Electronic Design, All About Circuits, Fare Elettronica, Elettronica Oggi, and PCB Magazine, as a technical writer/editor, specializing in several topics of electronics and technology. From 2015 to 2018, he was the editor-in-chief of Firmware and Elettronica Open Source, which are technical blogs and magazines for the electronics industry. He participated in many conferences as a speaker of keynotes for different topics such as x-ray, space technologies, and power supplies. Maurizio enjoys writing and telling stories about Power Electronics, Wide Bandgap Semiconductors, Automotive, IoT, Embedded, Energy, and Quantum Computing. Maurizio has been an AspenCore content editor since 2019. He is currently editor-in-chief of Power Electronics News and EEWeb and a correspondent for EE Times. He is the host of PowerUP, a podcast about power electronics, and the promoter and organizer of the PowerUP Virtual Conference, a summit where each year great speakers talk about the power electronics design trends. Moreover, he has contributed to a number of technical and scientific articles as well as a couple of Springer books on energy harvesting and data acquisition and control systems.

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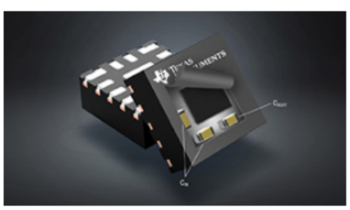

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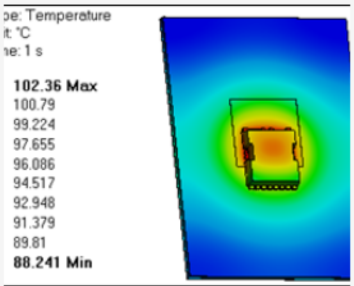

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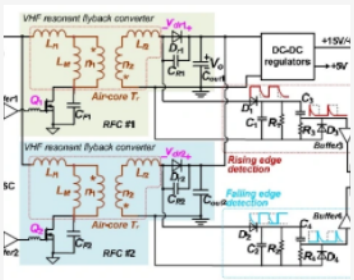

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